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DOUGLAS FIR CONE AND SEED INSECTS

(Progress Report*)

by

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April, 1955

Douglas fir cone and seed insects are an important limiting factor in the regeneration of Douglas fir. They not only cause a direct economic loss to the seed collector but also reduce seedfall on regenerating areas. Particularly in a year when the cone crop is sparse, cone and seed insects are capable of destroying nearly all of the seed produced. When there is a sparse cone crop distributed over a large area, the protection of cones from destructive insects by application of insecticides is not economical; on the other hand, in a year with an abundant cone crop the infestation of cones by destructive insects is usually light and probably will not require chemical protection. To assure a constant supply of superior Douglas fir seed, forest seed orchards are being established in the region. In these orchards protection of cones from destructive insects will be a necessity. Before any insect control in seed orchards can be applied successfully, basic information must be obtained on the insects involved, on their life cycles and damaging effects, and on time and methods of an effective insecticide application.

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Objectives

Objectives of the long-term investigation on Douglas fir cone and seed insects initiated in 1954, were:

1. to rear and determine the destructive as well as parasitic species,

2. to study their life cycles and habits,

3. to determine the damage on cones and seeds caused by each of the destructive species,

4. to assess the effect of parasitic insects on destructive species,

5. to relate the cone development to altitude in western Washington, and

6. to test the effect of insecticides on destructive and parasitic species; to find the optimal concentration as well as the method of application.

Because of the complexity of the problem, the investigations in 1954 were of a preliminary nature, the emphasis being placed on rearing and determination of species involved.

Destructive and Parasitic Insects

In 1953, there was a heavy infestation of Douglas fir cones by cone moths and midges on the St. Helens and Clemons Tree Farms. From the cones collected, a large number of parasitic species were reared. Data on cone and seed damage by insects, however, were not taken in 1953. In 1954, ninety-five cone bearing Douglas firs, 15 to 25 years old, were selected for biological studies of cone and seed insects on Clemons and St. Helens Tree Farms at different elevations. The cones were examined for insect damage at regular weekly intervals, from April 20 to September 17, when cones were collected for rearing purposes and for insect damage appraisal. At least 20 cones were taken at random from each tree; 10 cones for insect rearing and 10 for dissection. The cones were dissected longitudinally; the number of total seed on the cut surface, number of pollinated seed, number of destroyed seeds as well as number of destructive insects was recorded.

There was a great variation of cone infestation between the 1953 and 1954 season. While cone moths in 1953 were common, causing in many instances multiple attacks, the infestation by cone moths in 1954 was light, 6.4 per cent, (see table on next page) and nowhere in multiple attack. The large number of parasitic insects, reared mostly from the 1953 cone crop, is probably largely responsible for reduction of destructive species in the 1954 season. A list of destructive and parasitic insects is included on page 6.

Cone Damage by Destructive Insects

The cone moths, the fir cone geometrid and the cone sawfly bore through seeds and cone scales along the axis not showing preference for either. Later in the season they can be detected by the larval casting and pitch accumulated at the entrance hole. Careful examination of cones is necessary to detect the initial attacks which are marked by fine boring refuse and pitch at the entrance and are mostly covered by scales. A quantitative appraisal of seed losses caused by each single species was not performed. The fir geometrid and cone sawfly were found only occasionally in the 1954 season. The cone gall midges were common; they form galls in the scale tissue, not causing any evident deformation of cones. In only a few instances did they destroy seed. They are, therefore, of no real economic importance. Seed chalcids develop within the seed and destroy it. They were rare in the 1954 season. The percentages of cone infestation by cone moths, midges and chalcids are given in the check column of the table on the next page.

The Relationship of Cone Development to Elevation

As the development of cones and also the insect attacks depend on altitude, it was necessary to assess this relationship. One hundred and thirty-five Douglas firs bearing reproductive buds were selected at Black River near Rochester, at Clemons and at St. Helens on places with no exposure at elevations from 100 to 2,200 feet. The reproductive buds were examined for opening in weekly intervals during April and May. In the 1954 growing season, reproductive buds opened during the first week of April at the elevation of 100 feet, while at the elevation of 2,000 feet they opened during the third week in May. The opening dates for the intermediate elevations represent a straight line connecting the two extreme elevations.

Spraying with DDT Water Emulsion

At Clemons a small scale spraying experiment for cone protection was performed on forty cone bearing trees, 15-25 years old, at the elevation of 800-900 feet. At this elevation the reproductive buds first opened at the end of the third week in April. Four groups of trees (A, B, C, D) - each containing ten trees - were sprayed so that the A group was sprayed four times, B group three times, C group twice, and D group once. The first spray was applied on May 7, about two weeks after the reproductive buds opened. Approximately two gallons of two and one-half percent of DDT water emulsion was applied from the ground to each tree at 240-pound pressure. On September 18 at least ten cones were collected at random from each sprayed tree. They were dissected through the longitudinal axis for examination. The results are given in the table. The average number of seeds per cone was 9.7, the average number of pollinated seeds per cone was 3.9; thus pollination was 41 percent. Neither fir cone geometrid nor cone sawfly was encountered in sprayed cones. In the check cones they were found occasionally and were not included in the evaluation.

TABLE

Groups of Sprayed Trees	Date of Spraying				Percentage of Cones Infested By:				Number of Cones Exam.
	May 7	May 21	June 18	July 23	Cone Moths	Midges	Chalcid Wasps	All Insects Combined	
Group A (10 trees)	X	X	X	X	0.0	6.7	0.0	6.7	194
Group B (10 trees)		X	X	X	1.8	10.5	0.0	12.3	129
Group C (10 trees)			X	X	3.9	14.7	0.5	19.1	104
Group D (10 trees)				X	5.7	27.4	0.8	33.9	126
Check (40 trees)					6.4	30.1	1.1	37.6	664

Discussion

The spraying test was of a preliminary nature and at this low infestation not large enough to warrant definite conclusions. Yet, there is an indication that the application of spray two weeks after the buds opened protects them from cone moths' attacks and also from Chalcid wasp. The protection against midges was not complete, it probably could be increased by earlier application. Since the midges rarely destroy seeds, an extra application does not seem to be justified.

The DDT water emulsion adhered to young cones for about two months despite the frequent rains in the past season. Repeated application is necessary because of rapid growth of new cone tissue. The concentration of DDT emulsion was chosen arbitrarily and it proved to be high. In few instances the tender cone tissue was burned. - Life cycles of cone and seed insects have to be known before an adequate test of insecticides can be performed.

List of Douglas Fir Cone and Seed Insects

1. Destructive:

   a. The Douglas fir cone moth (Barbara colfaxiana Kearf., family Olethreutidae)

   b. The cone dioryctria (Dioryctria abietella (D. + S.), Pyralidae).

   c. The fir cone geometrid (Eupithecia togata spermaphaga (Dyar), family Geometridae)

   d. The Douglas fir cone sawfly (family Tenthredinidae, species not identified)

   e. The Douglas fir seed chalcid (Megastigmus spermotrophus Wachtl., family Torymidae)

   f. Two species of midges (family Cecidomyiidae)

   g. One species of seed psyllid (family Psyllidae)

2. Parasitic or Hyperparasitic (not yet identified to species):

   a. Four species of ichneumonid wasps

   b. Three species of braconid wasps

   c. Ten species of chalcidoid wasps belonging to the following families:

      Eulophidae (five species), Eurytomidae (one species), Torymidae (one species), Pteromalidae (one species), Perilampidae (one species), Ormyridae (one species).

As the rearing is not finished, the above list of insect species may be incomplete.